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The Effect of Tax Wedge and Industrialization on Female Labor Force Participation

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Abstract

The participation of women in the workforce is a factor that has very important socio-economic effects, especially on economic growth and development. Therefore, it is important to determine the factors affecting female labor force participation (FLFP) and thus to implement policies to increase FLFP. In the study, 17 OECD member countries were selected and the effects of tax wedge and industrialization on FLFP were examined based on the data of these countries for the period 2000-2019. It has been determined that industrialization generally affects FLFP positively, but the tax wedge has an effect on FLFP in a limited number of countries. In addition, while it is seen that both the tax wedge and industrialization are effective in the long term, it has been determined that only industrialization is effective in the short term and the tax wedge has no effect.

Key words: Tax Wedge, Industrialization, Female Labour Force Participation, OECD

JEL Code: E62, H31, J12, J16, J22, O14

1. Introduction

Female labor force participation (FLFP) gained importance with the industrial revolution. In the light of the developments created by industrialization, the demand for female labor has increased. Although the developments in the following periods increased the FLFP, women remained in the background compared to men. In today's world, women mostly work in the service sector. The industrial sector is a sector where FLFP is very low, but men are heavily employed. Increasing FLFP also contributes to the development of justice and democracy in a country. In addition, increasing FLFP plays an important role in the social,

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economic and political empowerment of the society. Especially today, developing countries attach great importance to women's workforce in ensuring economic development and therefore they develop policies to increase FLFP.

Although there are many studies in the literature on the factors that determine FLFP, it has been seen that there are few studies on the effect of tax wedge and industrialization, therefore, in this study, it is aimed to contribute to the literature by investigating the effects of these two factors on FLFP. In this context, the main purpose of the study is to investigate the effect of tax wedge and industrialization on FLFP in selected OECD member countries (Austria, Belgium, Canada, Chile, Iceland, Luxembourg, Netherlands, Spain, Denmark, France, Germany, Greece, Italy, United Kingdom, Sweden, Switzerland and Turkey). In the study, econometric analyzes were applied using the data of the 2000-2019 period. The data of the study were obtained from the OECD STAT website. The econometric findings obtained in the study were interpreted by creating tables.

2. Tax Wedge in OECD Member Countries

The concept of tax wedge, calculated as the ratio of taxes paid to income, was first used in 1919 in Sir Herbert Samuel's classic presidential speech to the Royal Statistical Institute; and then began to develop in 1927 when the Colwyn Committee published its report containing statistics up to 1925-1926 (Shirras, 1943: 214).

There are many factors that affect the tax wedge. These can be summarized as socioeconomic development, financial and organizational structure, globalization process, gross domestic product per capita, size of the industrial sector, openness, employment capacity and unemployment rate (Celikay, 2020: 27). It has been proven by various studies that the concept of tax wedge, which is affected by many factors, has important effects on issues such as investments, savings, economic growth, desire to work, innovation, and allocation of economic resources.

In Table 1, tax classification in OECD member countries is given. This classification is grouped under 6 headings.

Table 1. Classification of taxes according to OECD

Taxes on income, profits and capital gains	**Social security contributions**	**Payroll and labor taxes**	**Taxes on property**	**Taxes on goods and services**	**Other taxes**
Taxes on income,	Contributions of employees		Duplicate taxes on	Taxes on the	Only taxes

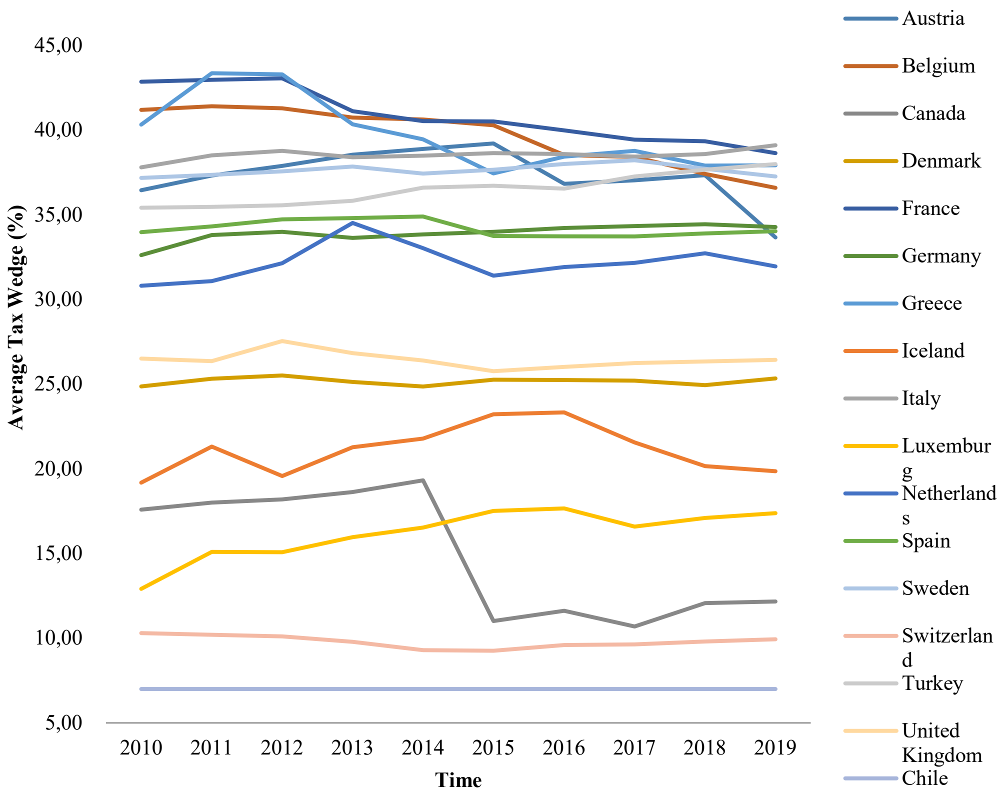
profit and capital gains of individuals			immovable property	production, sale, transfer, rental and delivery of goods and service provision	paid by the business
			Duplicate taxes on net wealth		
	Contributions of employers		Real estate, inheritance and gift taxes		
Corporate taxes on income, profits and capital gains			Taxes on financial and capital transactions	Taxes on the use of goods or on permission to use or operate goods	Taxes paid outside the business or by unknown persons
	Contributions of self-employed or unemployed		Other non-current taxes on property		
			Other double taxes on property		

Source: OECD (2020). Revenue statistics 1965-2019 Interpretative Guide. Date of access: 02.12.2021, https://www.oecd.org/tax/tax-policy/oecd-classification-taxes-interpretative-guide.pdf

When Table 1 is examined, it is seen that taxes are basically classified under 6 headings according to OECD. Taxes on income, profit and capital gains are divided into two as taxes on income, profit and capital gains of individuals and corporate taxes on income, profit and capital gains. Social security contributions are divided into three as employees, employers and self-employed or unemployed contributions. Taxes on property are divided into six types: double taxes on immovable property, double taxes on net wealth, real estate, inheritance and gift taxes, taxes on financial and capital transactions, other non-current taxes on property, and other recurring taxes on property. Taxes on goods and services are divided into two: taxes on the production, sale, transfer, rental and delivery of goods, and taxes on service provision, and taxes on the use of goods or permission to use or operate goods. Other taxes, on the other hand, are divided into taxes paid only by the entity and taxes paid by outsiders or by unknown persons.

As an indicator of the tax wedge in the countries covered in the study, the change in the % values of the average tax wedge if only one of the married couples with two children works is given in Graph 1.

Graph 1. Average tax wedge in the countries considered (%)



Source: OECD STAT 2020

In Graph 1, the average tax wedge values of the countries covered in this study for the period 2010-2019 are given. When the figure is examined, it is seen that there are increases and decreases in the average tax wedge values on a yearly basis in the countries covered. Among the countries considered, the countries with the lowest average tax wedge are Chile and Switzerland. The countries with the highest average tax wedge can be listed as Greece, France, Belgium, Italy, Sweden, Austria and Turkey.

3. Industrialization in OECD Member Countries

The concept of industrialization, which has an important place in the literature with the industrial revolution, can be defined as the increase in the ratio of the added value of the manufacturing sector to GDP (Chandra, 2003).

The idea that the development of the manufacturing industry, which is the locomotive of the economy, will accelerate economic development and increase the welfare level of countries has led all countries to industrialization. With industrialization, many socio-economic effects emerge in society. Since

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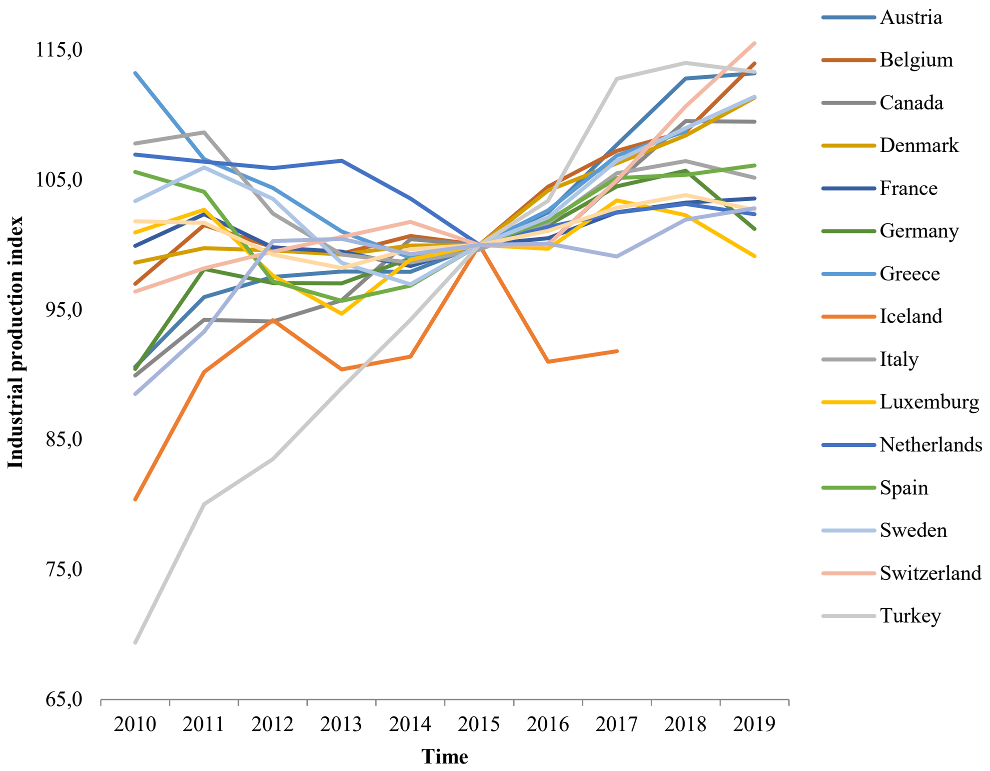
industrialization affects the social structure, education, employment, production, in-country and inter-country mobility, the environment and many other factors positively or negatively, it is a subject that needs to be addressed in particular. In Graph 2, the change in industrial production index values between 2010 and 2019 as an indicator of industrialization in the countries covered in the study is given.

Graph 2. Industrial production index value in the countries considered



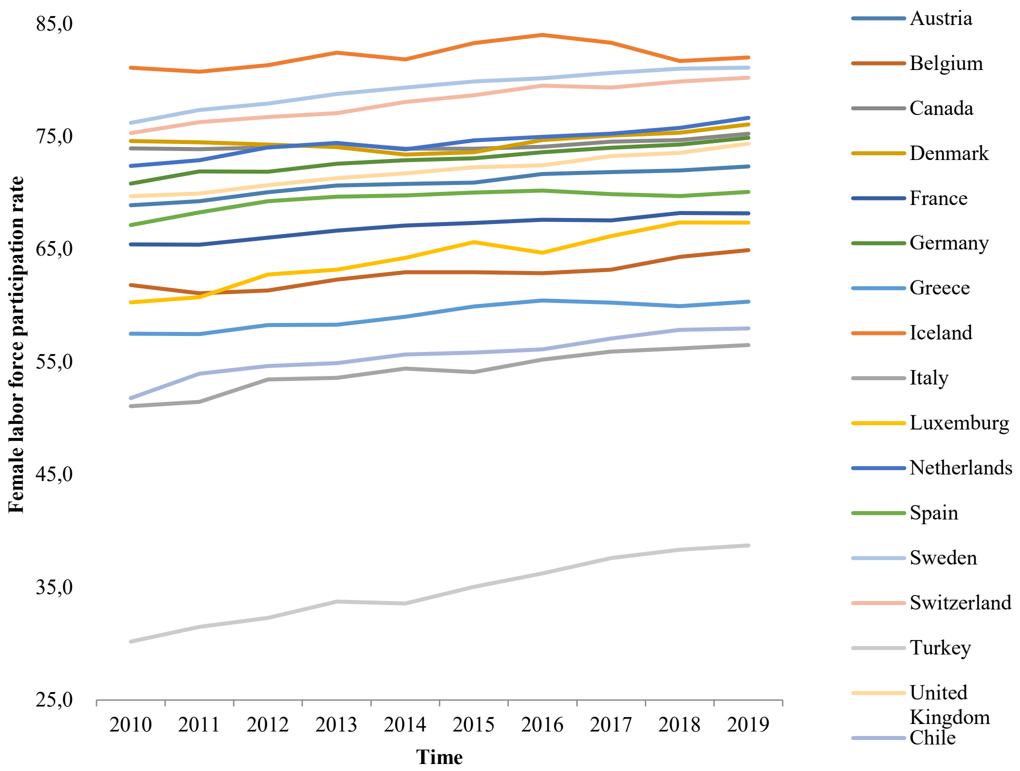
Source: OECD STAT 2020

In Graph 2, industrial production index values for the period of 2010-2019 in the OECD member countries covered in the study are given. When the figure is examined, it is seen that there are increases and decreases in the industrial production index values on a yearly basis in the countries covered in the study. Among the countries discussed, it is seen that Switzerland has the highest industrial production index values in recent years; Turkey, which had the lowest industrial production index value at the beginning, has recently increased its industrial production index value considerably.

4. Female Labor in OECD Member Countries

Since the employment of women in different sectors of the economy has an important role in the development and growth of the country's economy, it is of great importance to examine the issue of women's employment. For this purpose, the FLFP in the OECD member countries discussed in the study are given in Graph 3.

Graph 3. FLFP rates (15-64) in the countries considered



Source: OECD STAT, 2020.

In Graph 3, FLFP rates for the 2010-2019 period of the OECD member countries covered in the study are given. When the figure is examined, it is seen that Iceland is the country with the highest female labor force participation rate during the period under consideration, while Turkey is the country with the lowest. In addition, it was observed that FLFP rates generally increased during the observed period in all countries.

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5. Literature Review on the Tax Wedge and Industrialization's Relationship with Women Labor

In this part of the study, which investigates the effect of tax wedge and industrialization on FLFP, firstly, the studies in the literature that examine the effects of taxation and secondly industrialization on FLFP are mentioned. A very limited number of studies have been conducted in the international literature on the effect of taxation on the female workforce. One of these studies was done by Crossley and Jeon in 2007. In the study, the effect of the tax reform made in Canada in 1988 on the labor supply of married women is discussed. According to the findings of the study, it was seen that low-educated women married to high-income husbands increased their labor force participation as a result of the Canadian federal tax reform in 1988. From this point of view, it is understood that the labor supply of married women in Canada is quite tax sensitive.

Another study dealing with the relationship between taxation and women's labor supply was conducted in 2012 by Guner, Kaygusuz, and Ventura. In the study, the effects of tax reforms were measured by considering the labor supply of married women and the current demographic structure in the USA. According to the findings of the study, in a quantitative model, switching from joint taxation to individual taxation will significantly increase the labor supply of married women.

Another study was conducted in 2014 by Fuchs-Sch¨undeln and Bick. In the study, the relationship between taxation and the labor supply of married women is discussed based on the data of 18 OECD member countries. According to the results obtained from the study, it was determined that in one third of the countries studied, switching to a different taxation system would increase the labor supply of married women by more than 100 hours per year.

The main purpose of the study conducted by Colonna and Marcassa in Italy in 2015 is to investigate the relationship between taxation and female labor supply. The probit model was used in the study. According to the findings obtained in the study, it has been determined that the Italian individual taxation system creates deterrent factors for the labor supply of married women and women with children.

The main purpose of the study conducted by Kalíšková in 2020 is to measure the impact of tax-benefit policies on female labor supply on the basis of a large sample of 26 European countries between 2005 and 2010. The tax-benefit micro-simulation model (EUROMOD) is used to calculate a measure of incentives to work on the wide margin. According to the findings of the study, a 10-point increase in the participation tax rate reduces the employment probability of women by 2.5 points.

In this study, another concept in which the effect of FLFP is investigated is industrialization. There are very limited studies in the international literature on the effect of industrialization on the female workforce. One of these studies was conducted by Goldin and Sokoloff on North East America in 1982. In this study, it is aimed to investigate the role of women and children in the industrialization of Northeast America by using manufacturing firm data from the 1820-1850 period. Four different findings were obtained from the study. The first of these findings is that women and children make up a large proportion of the entire manufacturing workforce. The second finding from the study is that the employment of women and children is closely related to the production processes used by both mechanized and non-mechanized large organizations. Thirdly, with industrial development, women's wages are increasing compared to men. Finally, FLFP in industrial zones is significant.

According to a 1988 study by Acker based on research in the United States and Great Britain, women's apparent economic dependence reinforced their subordination as industrialization progressed in the 19th century. In developed industrial societies, the ideology of the man who provides the livelihood of the house and the dependent housewife continued to exist even in the face of a different reality, and continued the oppression of women and the privileges of men.

Another study dealing with the relationship between industrialization and women's employment was conducted by Del Alba Acevedo in 1990 on Puerto Rico. The study covering the period 1947-1982 presents the results of an empirical study of changes in the sectoral and occupational distribution of women's employment in Puerto Rico. Between 1947 and 1982, it was seen that women were slightly more advantageous than men in terms of labor force participation. In terms of employment, women have a relative advantage over men, as the average employment rate increases faster for women than for men. According to the findings of the study, in the first stage of industrial development characterized by the establishment of light industries, a significant percentage of women were employed in the manufacturing and service sectors of the economy. On the other hand, in the second phase, characterized by the establishment of heavy industries, female employment in the trade and public administration sectors increased significantly; female employment in the manufacturing and service sectors showed a decreasing trend compared to the previous stage.

The effect of industrialization on FLFP was discussed with the analysis made by Rau and Wazienski for 62 countries in 1999. In the study, it has been seen that early industrialization reduces women's participation in the labor force by excluding women from agriculture while also excluding them from production and management. However, in the later stages of industrialization, it has been observed that women's participation in the workforce has increased. Therefore, the findings obtained from the study support the U hypothesis.

The main purpose of the study conducted by Levenson in Taiwan in 2000 is to investigate the mobility of women in the industrialization process. According to the findings obtained in the study, the labor force participation rate of women working in agricultural areas has decreased. The main reason for this situation is the development of the manufacturing industry in Taiwan. However, with this development, some of the women working in the agricultural field have started to be employed in the manufacturing sector and the participation of young women in the workforce has increased, so there has been an increase in the labor force participation of women in general.

In the study conducted by Van in 2009, it is mentioned that women play an important role in the light manufacturing export industries, which is a springboard for sustainable growth in newly industrialized countries. According to the theory put forward in the study, women in low-growth developing countries mostly work in domestic services, while women in high-growth developing countries work in the manufacturing sector.

In the study conducted by Sorgner in 2021, first of all, a comprehensive literature review was conducted on the relationship between gender and industrialization in the context of developing countries. According to studies in the literature, differences in many issues such as FLFP, women's participation in politics and other gender roles have their origins in local pre-industrial conditions. One of the most striking results of the studies mentioned in the literature is that the differences in these roles tend to persist over time, even when societies move to a more advanced stage of development. According to the findings of the empirical analysis presented in Sorgner's study, developing countries that industrialize at a high rate generally have less gender equality than developing countries with a lower rate of industrialization.

6. Data and Method

In the study, 17 of the OECD member countries are selected and female labor force participation rates, tax wedge and industrial production index data for the 2000-2019 period are taken for these countries, and based on these data, the effect of tax wedge and industrialization on female labor force is investigated. The function of the model that will be based on in the study is as equation 1.

$$FLFP = f(ATW, IPI) \qquad (1)$$

Where FLFP, ATW, IPI refer to female labor force participation, average tax wedge and industrial production index, respectively. Then the model used in this study is as equation 2.

$$FLFP_{it} = \beta_{0i} + \beta_{1i}ATW_{it} + \beta_{2i}IPI_{it} + \varepsilon_{it} \qquad (2)$$

Where FLFP is the female labor force participation rate aged between 15-64, ATW is the average tax wedge for the one earner married couple with two children at 100% of average earnings, and IPI is the industrial production index relative to a base year 2015. All the data are obtained from OECD stat database.

Table 2. Descriptive statistics and correlation matrix for labor, industry and tax wedge for panel 17 OECD countries (2000–2019)

Descriptive Statistics	**Labor**	**Industry**	**Tax wedge**
Mean	64,97	98,60	29,08
Median	67,80	100,00	33,60
Maximum	84,01	140,23	44,32
Minimum	25,20	29,40	6,29
Standard Deviation	12,71	17,68	11,43
Observations	340	340	340
Correlation Matrix			
Labor	1,00		
Industry	0,07	1,00	
Tax wedge	-0,21	0,19	1,00

In table 2 descriptive statistics and correlation matrix are given. When the mean and median values of the variables are examined, it is seen that the industry variable has the highest values, while the tax wedge variable has the lowest values. While the female labor force participation rate ranged between 25% and 84% in the analyzed period, the average female labor force participation rate was 65%. While the industrial production index value ranged between 29% and 140%, it took the average value of 99%. In this period, while the tax wedge varied between 6% and 44%, the average tax wedge was 29%.

When the correlation matrix is examined, it is seen that female labor force participation has a positive correlation with the industrial production index and a negative correlation with the tax wedge.

In the study, panel data analysis is performed using these data. Panel data analysis enables researchers in social sciences to conduct longitudinal analyzes in a wide area. Panel data analysis is frequently used in economics, political science, psychology, sociology, education and health research. In economics, panel data analysis is used to examine the behavior of firms and people's wages over time (Yaffee, 2003: 1).

Panel data consists of a set of cross-section units observed over time, a combination of time series and cross-section data. (Yolanda et al., 2019: 3). Panel data analysis is very useful in identifying and estimating effects that simply cannot be detected in pure cross-section or pure time series data. On the other hand, panel datasets also have a significant impact on examining complex issues of dynamic behavior. For example, in a cross-sectional dataset, it can predict the unemployment rate at a given time point. However, repeated sections can show how this ratio changes over time. Therefore, panel data sets can contribute to predicting how many of those who are unemployed in one period will be unemployed again in another period (Abonazel, 2016: 46-58). Panel data also provides the opportunity to obtain more accurate estimates for individual results compared to time series data (Hsiao, 2003:7).

The panel data model can be represented as in equation 3.

$$Y_{it} = \alpha + \beta_{1it} X_{1it} + \ldots + \beta_{kit} X_{kit} + e_{it} \tag{3}$$

$$i = 1, 2, \ldots.., N \quad t = 1, 2, \ldots.., T$$

In equation 3, Y_{it} can be expressed as the dependent variable, X_{it} can be expressed as the independent variables, α as the constant term, β_{it} as the coefficients of the independent variables, and e_{it} as the error term.

In panel data analysis, whether there is a cross-section dependency in the series and whether the slope coefficients are heterogeneous are important issues taken into account in the stationarity tests. If there is a cross-sectional dependence in the series, second generation tests should be applied to these series to test for stationarity. However, the homogeneity or heterogeneity of the slope coefficients differentiates the type and interpretation of unit root and cointegration tests (Bilgili et al., 2017: 245). Panel data models allow the researcher to control for heterogeneity across units (Baltagi and Liu, 2008: 1).

Cross-Sectional Dependence

In order to test the existence of unit root in econometric applications related to panel data analysis, cross-section dependency should be tested. In this context, if the existence of cross-section dependence in the panel data set is not accepted, 1st generation unit root tests are used. However, if the panel accepts the presence of cross-sectional dependence, then the application of 2nd generation unit root tests will be important (Tugcu, 2018: 257).

In the study, Breusch-Pagan (1980) LM test and Pesaran (2004) CD_{LM} tests are used to determine cross-sectional dependence in series. The Breusch-Pagan (1980) LM test statistic can be calculated as in equation 4.

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^{2} \tag{4}$$

However, the Pesaran (2004) CD_{LM} test is calculated with the help of the formula given in the equation 5.

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{\rho}_{ij}^2 - 1) \tag{5}$$

It is assumed that the CD_{LM} test statistic calculated in the equation 5 shows a standard normal distribution asymptotically (Pesaran, 2004: 5).

In the literature, three different tests are used to test the cross-sectional dependence in the case of $T < N$: (i) Pesaran test (2004), (ii) Friedman statistics (1937) and (iii) Frees test (1995). Hypotheses for this test are:

H_0 = There is no cross-section dependency
H_1 = There is cross-section dependency

If the H_0 hypothesis is accepted based on the results of the tests applied in the analysis, first generation unit root tests are applied since there is no cross-sectional dependence. However, if the H_1 hypothesis is accepted, the second-generation unit root test is applied (Baltagi, 2008: 284).

Homogeneity Test

Homogeneity is of great importance in determining the appropriate unit root and panel cointegration in panel data analysis. The homogeneity of slope parameters is examined with the help of delta test. Homogeneity tests of slope coefficients were developed by Pesaran and Yamagata in 2008. Delta test statistic is presented in equation 6.

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right) \tag{6}$$

In equation 6, N is cross section dimension, $\tilde{S}$ is the modified Swamy statistic that has a chi-square distribution with k(N-1) degrees of freedom asymptotically when N is constant and T is infinite (Pesaran and Yamagata, 2008: 52-57).

Panel Unit Root

In order to see whether there is a long-term relationship between the series, first of all, the stationarity of the series and whether they are cointegrated to the same degree should be examined. In the Pesaran (2007) unit root test, there are CIPS results expressing the stationarity of each cross-section. For the CIPS statistic, the t-statistics calculated individually for each of the cross-sections are averaged.

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Cross-section-specific developed IPS (CIPS) test statistics, which is the arithmetic mean of the CADF model, is used. The hypotheses for this test are,

H_0: $\rho_i = 0$ (All sections in the series have a unit root.)
H_1: $\rho_i < 0$ (There is no unit root in at least one section in the series)

The CIPS test statistic is calculated with equation 7:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \qquad (7)$$

The CIPS test is applied in the stationarity analysis of the panel as a whole. The comparison of test statistics and critical values is based on their absolute values (Pesaran, 2007: 276).

Westerlund Panel Cointegration Test

Westerlund (2007) panel cointegration test is conceptually known as a cointegration analysis based on error correction model in order to test whether there is cointegration between two or more variables. This analysis is appropriate if the series are stationary at the same level. The cointegration test developed by Westerlund is presented in equation 8.

$$\Delta y_{it} = \delta_i' d_t + \alpha_i y_{it-1} + \lambda_i' x_{it-1} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta x_{it-j} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{it-j} + e_{it} \qquad (8)$$

Where d_t keeps the deterministic components while δ_i is the associated vector of the parameters. α_i is the error correction parameter and it is estimated by using the least squares method. Four new test statistics based on the least squares estimate of α_i given in the above equation and its t-ratio are presented by Westerlund: G_α, G_τ, P_α, P_τ.

In the calculation of G_α and G_τ values, which are group mean test statistics, the error correction model should be estimated for each section. Group mean test statistics are formulated in equation 9 and 10.

$$G_\alpha = \frac{1}{N}\sum_{i=1}^{N} \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)} \qquad (9)$$

$$G_\tau = \frac{1}{N}\sum_{i=1}^{N} \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \qquad (10)$$

The P_τ. and P_α values, which allow the panel to be analyzed as a whole, are formulated in equation 11 and 12.

$$P_\tau = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \tag{11}$$

$$P_\alpha = T\hat{\alpha} \tag{12}$$

Where $\hat{\alpha}_i$ is the semiparametric kernel estimator of α_i, and $SE(\hat{\alpha}_i)$ is the standart error of $\hat{\alpha}_i$ (Westerlund, 2007: 715-718).

AMG and PMG Tests

Augmented Mean Group (AMG) estimator, developed by Eberhardt and Bond (2009), is an estimator that can calculate the cointegration coefficients of both the countries forming the panel and the overall panel. In the AMG method, while calculating the long-term cointegration coefficient, which will be valid for the whole panel, the calculation is made by weighting the arithmetic average of the long-term co-integration coefficients of the cross-sections (Eberhardt and Bond, 2009: 5).

Eberhardt and Bond presented equation 13 to use in calculating the AMG estimator:

$$y_{it} = \beta_i' x_{it} + u_{it} \qquad u_{it} = a_i + \lambda_i' f_t + \varepsilon_{it} \tag{13}$$

$$x_{mit} = \pi_{mi} + \delta_{mi}' g_{mt} + \rho_{1mi} f_{1mt} + \cdots + \rho_{nmi} f_{nmt} + v_{mit} \quad (m = 1, \ldots, k \text{ and } f_{mt} \subset f_t)$$

$$f_t = \phi' f_{t-1} + \varepsilon_t \qquad g_t = \omega' g_{t-1} + \varepsilon_t$$

Where x_{it} is a vector of observable covariates, f_t and g_t are unobserved common factors, and λ_i is country-specific factor loadings.

The Panel Pooled Mean Group (PMG) model, developed by Pesaran, Shin, and Smith (1999), was established using the ARDL model with error correction terms and lagged variables. PMG can be accepted as an effective model in estimating short and long term relationships between variables through heterogeneous cross sections. PMG is effective and consistent and is presented in equation 14.

$$\Delta Y_{it} = \vartheta_i n_{it} + \sum_{j=0}^{q-1} \theta_{ij}' \Delta X_{it-j} + \sum_{j=1}^{p-1} \gamma_{ij} \Delta Y_{it-j} + e_{it} \tag{14}$$

$$n_{it} = \delta Y_{it-1} - \beta' X_{it}$$

Where Y_{it} is the dependent variable, X_{it} is a vector of explanatory variables, θ_{ij} is coefficient vectors, γ_{ij} is the coefficients of lagged variables, n_{it} is the error correction term, β is long term coefficients and ϑ is adjustment coefficients.

Dumitrescu-Hurlin Panel Causality Test

Dumitrescu and Hurlin proposed a simple Granger causality test for heterogeneous panel data models with constant coefficients in their paper in 2012. In this test, the main hypothesis of the absence of a homogeneous Granger causality relationship is tested against the alternative hypothesis that accepts the existence of this relationship in at least one cross-section. That is, the test takes into account the cross-sectional dependence between the countries that make up the panel. The advantage of this test compared to other tests is that it is insensitive to the difference in size between the time dimension and the section size. Dumitrescu and Hurlin (2012) investigated the causality relationship between Y and X with the help of the linear model given in equation 15.

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} Y_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \tag{15}$$

Here x and y are two stationary variables observed for N individuals at T periods; K indicates the lag length, which is identical for all cross sections. In addition, the slopes of autoregressive parameters Y_i^k and regression coefficients β_i^k differ between groups (Dumitrescu, Hurlin, 2012: 1450-1460).

7. Estimation Results

It is important to test the cross-section dependence and the homogeneity of the slope in the panel data model. The results obtained from the cross-section dependency test and slope homogeneity test are as seen in Table 3.

Table 3. Cross-sectional dependence and homogeneity tests

Test	**Statistic**	**P Value**
Cross-sectional dependence tests		
LM	391,60	0,00
LM_{adj}	33,65	0,00
CD_{LM}	81,56	0,00
Homogeneity tests		
Δ	20,48	0,00

Δ_{adj}	22,90	0,00

When the results obtained from the cross-section dependency test are examined, it is seen that all P values are less than the critical value of 0.05. Accordingly, there is a cross-sectional dependence between the series. According to the results of the cross-sectional dependency test, a shock that occurs in one of the countries examined may affect other countries as well.

When the results obtained from the homogeneity test are examined, it is seen that all P values are less than the critical value of 0.05. According to the results of the slope homogeneity tests, it is stated that the null hypothesis that the slope is homogeneous is rejected and therefore country-specific heterogeneity is supported.

The cross-sectional dependency test is also used when deciding which unit root test to apply while performing panel data analysis. According to Table 3, since it is concluded that there is a cross-sectional dependence between the series, it would be appropriate to use the second-generation unit root test when investigating the stationarity of the series.

Table 4. CIPS unit root test for panel 17 OECD countries (2000–2019)

Panel CIPS test	**Intercept**			**Intercept and trend**		
Labor	-1,82			-1,97		
ΔLabor	-3,76[a]			-4,26[a]		
Industry	-1,35			-1,01		
ΔIndustry	-2,82[a]			-2,95[a]		
Taxwedge	-1,45			-2,02		
Δtaxwedge	-4,24[a]			-4,38[a]		
Critical values	**10%**	**5%**	**1%**	**10%**	**5%**	**1%**
	-2,1	-2,21	-2,4	-2,63	-2,73	-2,92

[a] Illustrates 1% statistical significance

In order to test the stationarity of the series, the CIPS test, which is one of the second-generation unit root tests, was applied. If the CIPS test table values are greater than the critical values in absolute value, the basic hypothesis that there is a unit root in the series is rejected and the alternative hypothesis that there is no unit root in the series is accepted (Pesaran, 2007: 265-312). When the results obtained from the CIPS test are examined, it is seen that the series are not stationary at the level, but become stationary when the first difference is taken.

Since all series become stationary when the first difference is taken, it can be examined whether there is a cointegration relationship between the variables. In case of cross-sectional dependence between the series, spurious cointegration results may occur if general cointegration tests are used. To solve this problem, Westerlund proposed four cointegration tests based on the error correction model: G_{alpha}, G_{tau}, P_{alpha} and P_{tau}. In the G_{alpha} and G_{tau} test, the rejection of H_0 indicates cointegration in at least one of the cross-section units; while the rejection of H_0 in the P_{alpha} and P_{tau} tests indicates cointegration in the entire panel.

Table 5. Westerlund ECM panel cointegration tests

Relationship Tested	G_t	G_a	P_t	P_a
Labor and Industry	-2,85[a]	-25,32[a]	-7,50	-11,89[b]
Labor and Tax Wedge	-2,64[c]	-22,36[a]	-3,07	-6,62

Notes: Optimal lag and lead lengths selected via AIC are both 1 and optimal Barlett Kernel window width is set to be 3.

[a] Illustrates 1% statistical significance
[b] Illustrates 5% statistical significance
[c] Illustrates 10% statistical significance

According to Table 5, when the G_a and G_t test results for the labor and industry variables are examined, it is seen that H_0 was rejected at the 1% significance level. In other words, there is a cointegration relationship between the labor and industry variables in at least one cross-sectional unit. When the P_t and P_a test results are examined, it is seen that H_0 for P_t cannot be rejected, but H_0 for P_a is rejected at the 5% significance level. In other words, according to the P_a test, there is a cointegration relationship for the entire panel at the 5% significance level.

When the G_a test result for labor and tax wedge variables is examined, it is seen that H_0 is rejected at the 1% significance level, and when the G_t test result is examined, it is seen that H_0 is rejected at the 10% significance level. Accordingly, there is a cointegration relationship between the labor and tax wedge variables in at least one cross-section unit. When the P_t and P_a test results are examined, it is seen that H_0 could not be rejected for both tests. In other words, there is no cointegration relationship between the labor and tax wedge variables for the entire panel.

In the next step, the long-term parameters of the independent variables were estimated by using the augmented mean group estimator (AMG). Table 6 shows the AMG estimator results.

Table 6. Cointegration coefficients obtained from AMG estimator

Country	**Industry**	**Tax wedge**
Austria	-0,022 (0,556)	0,202[b] (0,038)
Belgium	0,082 [b](0,019)	-0,101 (0,482)
Canada	-0,014 (0,651)	0,051 (0,521)
Denmark	0,103 [a](0,000)	0,204 (0,540)
France	-0,013 (0,369)	-0,150[a](0,003)
Germany	0,096 [a](0,005)	-0,559 [a](0,005)

Greece	-0,015 (0,441)	0,190 [b](0,037)
Iceland	-0,065[c] (0,099)	-0,041 (0,816)
Italy	0,032 (0,214)	-0,150 (0,400)
Luxemburg	0,028 (0,317)	-0,023 (0,873)
Netherlands	0,116[a] (0,006)	0,066 (0,639)
Spain	-0,052 (0,402)	0,575 (0,477)
Sweden	-0,026 (0,178)	0,719 [a](0,000)
Switzerland	-0,053 (0,192)	-0,079 (0,790)
Turkey	0,164 (0,292)	-0,079 (0,803)
United Kingdom	0,185[a] (0,000)	-0,416 [b](0,010)
Chile	0,034 (0,720)	1,363 (0,497)

Values in parentheses are probability values.
[a] Illustrates 1% statistical significance
[b] Illustrates 5% statistical significance
[c] Illustrates 10% statistical significance

Results can be classified under two groups:

a) While the increase in the industrial production index in Belgium, Denmark, Germany, the Netherlands and the United Kingdom affects women's employment positively, it affects negatively in Iceland. In the remaining 11 countries, the industrial production index did not have a statistically significant effect on female labor force participation. Therefore, industrial production does not affect FLFP in these 11 countries.

b) While the tax wedge positively affects FLFP in Austria, Greece and Sweden, it affects negatively in France, Germany and the United Kingdom. In the remaining 11 countries, no statistically significant effect of the tax wedge on FLFP was found. Therefore, the tax wedge does not affect FLFP in these 11 countries.

After AMG analysis, to see the short and long-run estimations error correction-based PMG analyses are made. The results of PMG analyses based on error corrections are given in Table 7.

Table 7. PMG analyses based on the error correction (short-run and long-run estimations)

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Dependent Variable: Labor		
Variables		
Long run	**Industry**	**Tax Wedge**
	0,184[a] (0,000)	-0,370[a] (0,000)
Short run	**ΔIndustry**	**ΔTax Wedge**
	-0,029[a] (0,001)	0,074 (0,121)
Constant	8,751[a] (0,005)	
Error Correction	-0,140[a] (0,005)	

Values in parentheses are probability values.
[a] Illustrates 1% statistical significance

According to table 7, both the industrial production index and the tax wedge have long-term effects on FLFP. Therefore, it can be said that industrial production index and tax wedge are among the possible important determinants of FLFP. However, in the short run, only the industrial production index was found to be important to explain the change in female labor force participation.

In the next step, Dumitrescu-Hurlin panel causality test was conducted in order to investigate the mutual causality relationship between the variables.

Table 8. Dumitrescu & Hurlin (2012) panel causality test

Null hypothesis: No causality	
Industry→Labor	**Tax wedge→Labor**
2.891[a] (0,000)	1,422 (0,219)
Labor→Industry	**Labor→Tax wedge**
2,298[a] (0,000)	3,071[a] (0,000)

Wald Statistic: Values in parentheses are probability values.
[a] Illustrates 1% statistical significance

According to Table 8, when the relationship between FLFP and industrial production index is examined, it is seen that there is a mutual causality relationship between the two variables. When the relationship between tax wedge and FLFP is examined, it is seen that FLFP is the reason for the tax wedge, but the tax wedge is not the reason for women's participation in the labor force.

In order to observe the country-specific results in particular, Table 9 shows the individual results of the Dumitrescu and Hurlin panel Granger causality tests used for the heterogeneous panel data models.

Table 9. Dumitrescu and Hurlin [92] panel causality test (country-specific causality)

Country	Null hypothesis: No causality	
	Industry→Labor	**Tax wedge→Labor**
Austria	5,998[b] (0,026)	1,823 (0,196)
Belgium	1,157 (0,298)	1,175 (0,294)
Canada	1,545 (0,232)	3,764[c] (0,070)
Denmark	4,884[b] (0,042)	0,007 (0,935)
France	0,006 (0,941)	0,105 (0,750)
Germany	0,170 (0,685)	0,561 (0,465)
Greece	1,011 (0,330)	0,063 (0,805)
Iceland	1,453 (0,246)	0,850 (0,370)
Italy	0,825 (0,377)	0,751 (0,399)
Luxemburg	0,435 (0,519)	0,082 (0,778)
Netherlands	1,618 (0,222)	1,352 (0,262)
Spain	1,442 (0,247)	0,003 (0,957)
Sweden	1,523 (0,235)	1,194 (0,291)
Switzerland	19,403[a] (0,000)	0,511 (0,485)
Turkey	3,965[c] (0,064)	7,473[b] (0,015)
United Kingdom	0,019 (0,893)	0,488 (0,495)
Chile	3,695[c] (0,073)	3,975[c] (0,064)

Wald Statistic: Values in parentheses are probability values.
[a] Illustrates 1% statistical significance
[b] Illustrates 5% statistical significance
[c] Illustrates 10% statistical significance

When Dumitrescu Hurlin panel causality results are analyzed on the basis of countries, it is seen that there is a causal relationship from the industrial production index to FLFP for Austria, Denmark, Switzerland, Turkey and Chile. For the remaining 12 countries, a causal relationship from the industrial production index to FLFP could not be found. When the causality relationship between tax wedge and FLFP is examined, it is seen that tax wedge is the reason for FLFP in Canada, Turkey and Chile, while tax wedge is not the reason for FLFP in the remaining 14 countries.

8. Conclusions

Population and workforce have very important effects on economic growth and development. Despite the fact that women make up about half of the population, the value of the female workforce in the economy was not known much before, but it has begun to be understood more and more, especially with industrialization. Thereupon, studies have been started to increase the FLFP. There are many factors that affect FLFP. However, it has been observed that the effect of tax wedge and industrialization factors among these factors has not been studied much in the literature. Therefore, in this study, the short and long-term effects of tax wedge and industrialization on FLFP were investigated by applying panel data analysis, using the data of the 2000-2019 period of 17 selected OECD countries.

In the study, firstly, cross-section and homogeneity tests were carried out, and according to the results of these tests, it was determined that there was a cross-sectional dependence between the series and that the series were not homogeneous. Thereupon, it was decided that 2nd generation unit root tests were appropriate and CIPS unit root test was applied. As a result of this test, it was seen that the series were not stationary at the level, but became stationary when their first difference was taken. This means that a cointegration test can be applied to the series.

According to the cointegration result of the Westerlund ECM panel applied on this, there is a cointegration relationship between the FLFP and industry variables in at least one cross-sectional unit. In addition, it was observed that there was a cointegration relationship between FLFP and industrialization for the entire panel. Again, according to the Westerlund cointegration test, there is a cointegration relationship between FLFP and tax wedge variables in at least one cross-section unit. However, it was concluded that there is no cointegration relationship between FLFP and tax wedge for the entire panel.

Next, the long-term parameters of the independent variables were estimated by using the AMG test. While the increase in the industrial production index in Belgium, Denmark, Germany, the Netherlands and the United Kingdom affects FLFP positively, it affects negatively in Iceland. In the remaining 11 countries, industrial production does not affect FLFP. While the tax wedge positively affects FLFP in Austria, Greece and Sweden, it affects negatively in France, Germany and the United Kingdom. In the remaining 11 countries, the tax wedge does not affect FLFP.

To see the short and long-run estimations error correction-based PMG analyses are made. According to the PMG analyses both the industrial production index and the tax wedge have long-term effects on FLFP. However, in the short run, only the industrial production index was found to be important to explain the change FLFP.

In the next step, Dumitrescu-Hurlin panel causality tests are employed. When the relationship between FLFP and industrial production index is examined, it is seen that there is a mutual causality relationship between the two variables. When the relationship between tax wedge and FLFP is examined, it is seen that FLFP is the reason for the tax wedge, but the tax wedge is not the reason for FLFP.

After that, Dumitrescu Hurlin panel causality results are analyzed on the basis of countries. It is seen that there is a causal relationship from the industrial production index to FLFP for Austria, Denmark, Switzerland, Turkey and Chile.

For the remaining 12 countries, a causal relationship from the industrial production index to FLFP could not be found. When the causality relationship between tax wedge and FLFP is examined, it is seen that tax wedge is the reason for FLFP in Canada, Turkey and Chile, while tax wedge is not the reason for FLFP in the remaining 14 countries.

When the results of the analysis are examined in general terms, it has been determined that industrialization has a positive effect on FLFP in general, but the tax wedge has an effect on FLFP in a limited number of countries. In addition, while it is seen that both the tax wedge and industrialization have an effect on the FLFP in the long run, it has been determined that only industrialization is effective in the short run and the tax wedge has no effect.

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